stick to the inside of the channel 2, and they are formed while having the metallic beam during the evaporation incident at a steep angle on the insulating substrate 1 on which the channel 2 is formed. Or, it is also possible to form it by a printing method not to close the pores of the channel 2.

According to the present invention, it is possible to form a strong and homogeneous channel over large area exceeding a micro-size by using aluminum as the material for forming the insulating substrate so that the channel plate of high resolution advantageous for the large area can be acquired.

In addition, it is possible to form the irregular and minute asperities on the electron multiplier surface inside the channel so as to acquire the high secondary electron multiplication factor.

Furthermore, according to the manufacturing method of the present invention, the insulating substrate having the channel is formed by regularized aluminum anodic oxidation, and so the channel having the electron multiplier surface of the high secondary electron emission efficiency can be easily formed over the large area in a high-resolution manner without undergoing a high temperature process.

Moreover, the above-mentioned channel plate may be applied to an X-ray diagnosing apparatus, an X-ray material inspection apparatus and so on.

(Embodiment)

The present invention will be described in detail by taking up an embodiment below.

Embodiment 1

The channel plate of a size of approximately 10 cm was produced.

It will be described hereafter by referring to FIGS. 4A to 4D.

First, the aluminum plate of approximately 12 cm in diameter was prepared as a material substrate 10 of the insulating substrate 1 (see FIG. 4A). As for the aluminum plate, one having purity of 99.9 percent or more aluminum was used. First, electrolytic polishing of the surface was performed in order to make the aluminum plate surface even. As for the electrolyte, a mixture of per-chlorous acid ($HClO_4$) and ethanol (C_2H_5OH) was used to perform it at 100 mA/cm^2 for three minutes.

Next, the pore 6 was formed on the substrate 10 by the aforementioned two-phase anodic oxidation.

An anodic oxidation condition for the first time was 195V, 10 hours in phosphoric acid aqueous solution of 0.3M of which water temperature was kept at 0° C. Next, etching was performed in the mixture aqueous solution of chromic acid and phosphoric acid of which water temperature was kept at 60° C for 10 hours or so to remove the anodic oxidation layer of the first time.

Although the anodic oxidation layer was mostly removed, regular asperities were left on the aluminum plate surface.

Next, the aluminum substrate thus etched was anodized for the second time on the same condition as the first time. Thus, the insulating substrate 1 having regularly formed pores was formed (see FIG. 4B).

The extremely thin oxidation layer was left at the pore bottom 11. This zone was removed so as to have the pores extend through the substrate and form the channel 2 as shown in FIG. 4C. The etching was performed by soaking it in saturated Hg_2Cl_2 solution.

Thereafter, it was soaked in 10 wt% phosphoric acid solution for four hours and the pore widening process was performed to extend the pore diameter.

As a result of observing the insulating substrate formed on this condition with an electron microscope, the pores of approximately 250 nm in diameter were formed on the substrate of several hundreds μm in thickness.

The inside of the pore thus formed by the aluminum anodic oxidation formed the uneven surface with irregular and minute asperities.

Thereafter, the inside of the pore was coated with grains. MgO grains were formed by a solgel method. This formed even more minute asperities inside the pore to form the channel 2 having the electron multiplier